



## Seattle-King County EMS

Emergency Medical Services Division  
Public Health - Seattle/King County  
999 3<sup>rd</sup> Avenue, Suite 700  
Seattle, Washington 98104  
(206) 296-4863

January 2006

CBT/OTEP 442

# Stroke

print version of EMS Online Course  
[www.emsonline.net](http://www.emsonline.net)

## Stroke

# Introduction

Recent advancements in the acute care of stroke patients are giving hope for restoration of lost neurological function. The key for many stroke patients is getting clot-busting therapy within three hours of the onset of symptoms.

EMS providers are a vital link between the patient and new therapies that can greatly improve the lives of stroke patients. When it comes to strokes, "time is brain cells."

### Before You Begin

This is a continuing education and recertification course for EMTs. It covers fundamental EMT-Basic concepts and terminology as well as advanced material. We highly recommend completing the case studies and practice exam before completing the exam. We also recommend that you review an EMT textbook chapter covering stroke as a refresher before taking the exam; for example: Chapter 13 in *Emergency Care and Transportation of the Sick and Injured*, 9th edition (AAOS).

### Practical Skills

To receive CBT or OTEP credit for this course a trained skills evaluator must evaluate your ability to perform the following hands-on practical skills.

- initial assessment (SICK/NOT SICK)
- patient history
- Cincinnati Prehospital Stroke Scale
- recognition of need for short scene times
- care for stroke

Go to the Downloads section of EMS Online to download the Skills Checklist for this course (click "2006 CBT/OTEP Skills Checklists").

### Course Objectives

CBT442 is an online EMS continuing education module for EMS providers including first responder and emergency medical technician. After completing this course you will be able to:

1. Identify the major regions of the brain and their functions.
2. Identify the two types of stroke.
3. Identify the underlying causes of an ischemic stroke.
4. Identify the underlying cause of a hemorrhagic stroke.
5. Identify the signs and symptoms of stroke.
6. Identify proper application of the Cincinnati Prehospital Stroke scale.
7. Identify the reasons why a stroke patient must be assessed and transported quickly.
8. Identify the steps in the emergency assessment and care for the patient experiencing a stroke.

## Stroke

# Terms

### Terms You Should Know

**atherosclerosis** — A condition characterized by the deposit of fatty plaques containing cholesterol and lipids on the innermost layer of the walls of large and medium-sized arteries.

**embolism** — A clot that travels from one part of the body to another until it becomes lodged in one of the small arteries of the brain and blocks blood flow.

**hemorrhagic stroke** — A type of stroke that occurs when a blood vessel bursts inside the brain.

**infarction** — A localized area of cell death due to a lack of oxygenated blood.

**ischemia** — A deficiency of oxygenated blood in a body part as a result of a constriction or blockage of the blood vessel.

**stroke** (CVA) — A vascular disease that affects the blood vessels supplying blood to the brain. A stroke occurs when a blood vessel bringing oxygen and nutrients to the brain bursts or is clogged by a blood clot or embolus. A stroke can cause neurological deficits.

**thrombus** — A blood clot that typically forms over fatty plaque deposits that form on the inner wall of arteries. This plaque and subsequent narrowing may progress slowly over years, particularly in those patients who smoke or have high cholesterol or high blood pressure.

**transient ischemic attack** (TIA) — A disorder of the brain in which brain cells temporarily stop working because of insufficient oxygen causing stroke-like symptoms that resolve completely within 24 hours of onset.

### New Terms

**aphasia** — Partial or total loss of the ability to articulate ideas or comprehend spoken or written language.

**dysarthria** — Difficulty in pronouncing words, caused by impairment in the control of the muscles used in speech.

**foramen magnum** — An opening in the base of the skull through which the spinal cord passes to the cranial cavity and becomes the medulla oblongata.

**hyperlipidemia** — Elevated blood fat levels, particularly LDL cholesterol.

**receptive aphasia** — Aphasia in which the ability to comprehend written or spoken words is diminished or lost. Also called *sensory aphasia*.

**expressive aphasia** — Aphasia in which the power to communicate by writing, speaking, or using signs is diminished or lost. Also called *motor aphasia*.

**hemiparesis** — Partial weakness affecting one side of the body.

**hemiplegia** — Complete paralysis on one side of the body.

**paresis** — Slight or partial paralysis.

## Stroke

# Resources

### **American Stroke Foundation**

Stroke news for professionals

<http://www.americanstroke.org/>

### **Internet Handbook of Neurology**

Dozens of links to stroke-specific topics

<http://www.neuropat.dote.hu/stroke1.htm>

### **National Stroke Association**

<http://www.stroke.org>

### **National Institute of Neurological Disorders and Stroke**

Extensive links to detailed information on stroke

<http://www.ninds.nih.gov/disorders/stroke/stroke.htm>

### **Washington University Stroke Center**

Excellent resource with current information and image database

<http://www.strokecenter.org/>

### **Traumatic Brain Injury Resource**

Detailed information on the central nervous system

<http://www.neuroskills.com/index.html>

## Stroke

# Brain

The two parts of the central nervous system are the brain and the spinal cord. The central nervous system is responsible for controlling both the voluntary and involuntary activities of the human body.



The brain is the most highly specialized organ in the body. It is richly supplied with blood and demands an adequate and constant supply of oxygen. There are three regions that are important for you to know: the **cerebrum**, **cerebellum** and **brain stem**.

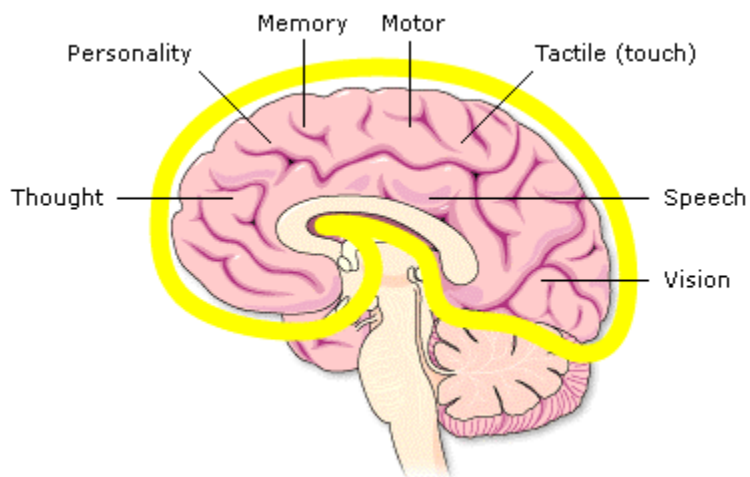
### Cerebrum, Cerebellum and Brain Stem

Functions such as emotion, thought, vision, movement, sensation and language, reside in the cerebrum. Coordination of body movement is controlled by the cerebellum. The brain stem controls the most primitive functions including respiratory and cardiac functions.

## Stroke

# Cerebrum

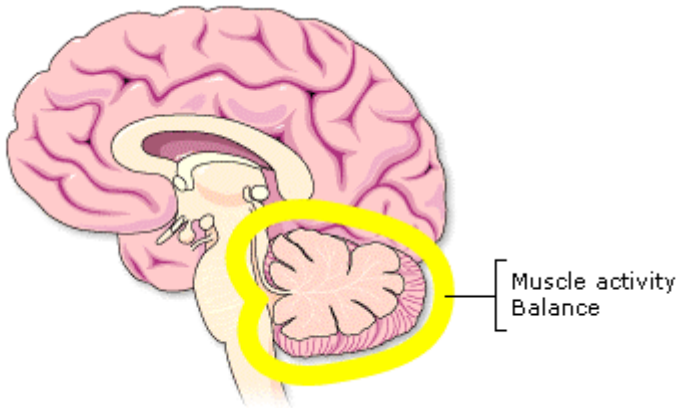
The **cerebrum** is the largest region of the brain and occupies most of the space in the cranium. The cerebrum creates and controls conscious thought, memory, personality, speech, motor function, vision and tactile (touch) impulses.



The left hemisphere usually contains the speech area (even in left-handed individuals, though in a slightly lower percentage).

**Stroke****Cerebellum**

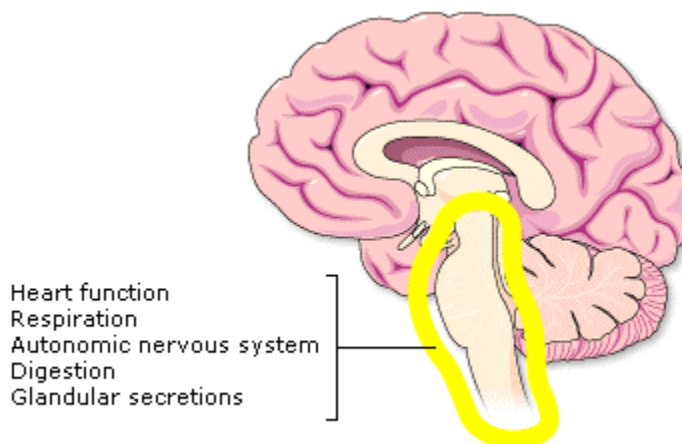
The **cerebellum** is located below and behind the cerebrum in the base of the skull. Its primary function is to regulate and coordinate muscle activity and balance through impulses it receives from the eyes, the ears and the peripheral joints and muscles.





**Stroke****Brain Stem**

The **brain stem** controls basic functions vital to survival such as digestion, heart function, respiration, glandular secretions and the autonomic nervous system.



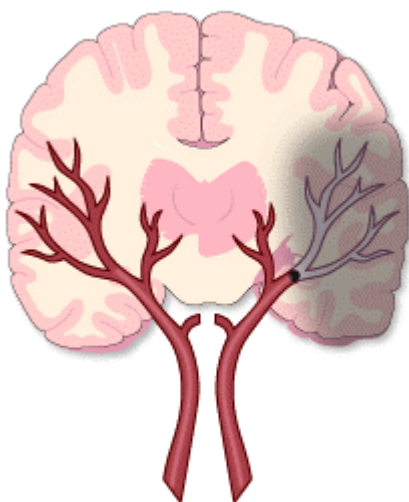
It connects the brain to the spinal cord, passing through a hole in the base of the skull called the foramen magnum. Increased intracranial pressure can force the lower brain structures through the foramen magnum and produce herniation syndrome with evidence of brain stem dysfunction.

## Stroke

# Ischemic Stroke

A stroke is a condition in which loss of brain function occurs due to an abnormality of blood circulation to an area of the brain. The two major types of stroke are ischemic (blockage) and hemorrhagic (rupture/bleed).

An **ischemic stroke** results from either a clot that develops in an artery at the site of the blockage (thrombus) or one that floats to the site to form a blockage from a different part of the body (embolus). This clot prevents oxygenated blood from reaching the downstream brain tissues.



If the initial onset of symptoms is not devastating, the vast majorities of ischemic stroke patients survive, but with limited prospects of regaining function unless given clot-dissolving drug therapy within three hours. This three-hour window starts at the onset of symptoms and must be reliably determined.

Ischemic stroke patients need clot-busting drugs within three hours of reliably timed symptom onset.



**You may have just minutes to get the patient to definitive treatment depending on the time of onset.**

## Stroke

# Cerebral Thrombus

One cause of an ischemic stroke is the formation of a thrombus. A **thrombus** is a blood clot that forms locally near an area of plaque. The clot causes a sudden occlusion of the blood vessel.

In the cerebral arteries when blood flow stops it produces a sudden onset of neurological deficits. Outward signs and symptoms are dependent on which area of the brain is affected.

## Causes of a Thrombus

Artherosclerosis is the process of fatty plaque deposits forming on the inner wall of an artery. This narrows the artery slowly over many years, particularly in people with a history of smoking, high cholesterol, high blood pressure or diabetes.

A sudden blockage can occur when the cholesterol-rich plaque ruptures and platelets adhere to the ulcerated surface. This event triggers a number of vascular responses and blood clotting mechanisms.

The pathophysiology for thrombosis is the same as in a heart attack and has led to the same diagnostic and therapeutic approaches. These approaches include rapid diagnosis, early attempts to revascularize the ischemic area and preventive measures which control hypertension, hyperlipidemia and thrombosis.

## Stroke

# Embolus

Another cause of an ischemic stroke is an embolus. An **embolus** is a clot that forms elsewhere in the body and circulates in the bloodstream until it gets stuck in an artery.



When an embolus blocks an artery, the tissues beyond the plug are deprived of normal blood flow and oxygen. This can cause ischemia and even death of the tissues involved. Clot-busting drugs can help individuals with an ischemic stroke if administered within three hours from time of onset.

## Causes of an Embolus

An embolus can affect any part of the body. The most common sites are the legs and feet. When the brain is involved this causes a stroke. When the heart is involved, it is called a myocardial infarction.

An embolus can be a blood clot, fat cells or an air bubble. A common cause of an embolus is when cholesterol builds up in an artery whose inner lining has become thickened or damaged. If part of the cholesterol breaks off, it becomes an embolus.

Emboli commonly form from blood clots in a heart that has been damaged from heart attack or when the heart contracts abnormally from atrial fibrillation. Approximately 20% of ischemic strokes are caused by emboli that come from the heart.

Other causes of emboli include fat cells that enter the blood due to a major bone fracture, infected blood cells, small gas bubbles, or cancer cells that enter the blood stream.

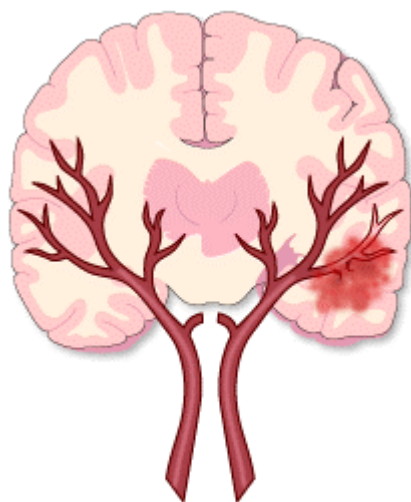
## Stroke

# Hemorrhagic Stroke

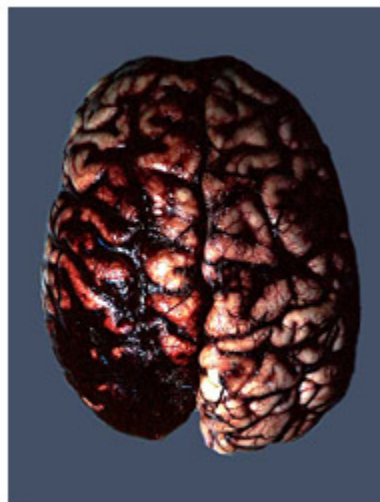
**Hemorrhagic stroke** results from either a ruptured blood vessel on the surface of the brain (subarachnoid hemorrhage) or within the brain (intracerebral hemorrhage). The effects of a burst blood vessel put pressure against the brain. This prevents oxygenated blood from reaching the cells.

The signs of hemorrhagic stroke can appear rapidly. Many individuals experience a sudden, severe headache due to blood that irritates the brain tissue and increasing pressure on the brain.

The prognosis for hemorrhagic stroke is poor compared to that of ischemic stroke. Approximately 50% of patients who suffer an intracerebral hemorrhage die within the first year after the event. The prognosis for those who survive is variable, depending on the type of hemorrhage (subarachnoid vs. intracerebral), the size, the location and existing medical conditions.



**Intracerebral hemorrhage**



**Subarachnoid hemorrhage**

Photo credit: Gregory Pinsky, MD, USC Neuropathology

## Types of Hemorrhagic Stroke

A *subarachnoid hemorrhage* occurs when an aneurysm bursts in the outer coverings of the brain within the subarachnoid space. The area rapidly fills with blood. There may be a sudden, intense headache, neck pain and nausea or vomiting. It is often described as "the worst headache of my life."

An *intracerebral hemorrhage* is usually caused by bursting of small blood vessels weakened by years of high blood pressure. Less commonly, it is caused by abnormal tangles of blood vessels called vascular malformations. In this type of hemorrhagic stroke, blood accumulates in the brain tissues and can extend into the space between the brain and the membranes covering it.

## **Aneurysms**

A common cause of a ruptured artery in the brain is an abnormality or weakness in the vascular wall called an aneurysm. This is more likely to occur in patients with existing aneurysms of cerebral vessels (berry aneurysms), hypertension or with congenital malformations of the cerebral blood vessels.

## **Cushing's Response**

Cushing's Response (Cushing's Triad) is a phenomenon in which an increase in intracranial pressure results in an increased blood pressure, a decreased heart rate and irregular breathing.

## Stroke

# Transient Ischemic Attack

A **transient ischemic attack** (TIA) is a condition in which brain cells temporarily stop working because of insufficient oxygen. This causes temporary stroke-like symptoms that resolve completely within 24 hours of onset.

TIA's often precede a stroke. At the time of symptoms, it is impossible to distinguish a stroke from a TIA. If the symptoms resolve, the episode is considered a TIA. If the symptoms remain beyond 24 hours it is considered a stroke.

### Time Duration of TIAs

The symptoms of a TIA are rapid in onset. Symptoms generally subside within five minutes and often in less than one minute. Symptoms vary in duration from 2 to 15 minutes, but the vast majority last less than one hour.

## Stroke

# Risk Factors

Factor	Risk
Hypertension	High blood pressure (140/90 mmHg or higher) is the most important factor in stroke.
Smoking	The damage of cigarette smoke to the cardiovascular system increases the risk of stroke just as it increases the risk of coronary artery disease.
Age	The chance of stroke more than doubles for each decade of life past the age of 55. While stroke is common in the elderly, substantial numbers of people under 65 have strokes.
Gender	In most age groups, more men than women have strokes in a given year, the exception to this rule is subarachnoid hemorrhage, the only stroke type more common in women than men. However, women account for more than half of all stroke deaths.
Heredity	The probability of stroke is much higher in families with a history of stroke.
Prior stroke	Previous events increase the risk of another.
Diabetes	Diabetes is strongly connected to HTN and high cholesterol. Vascular injury associated with diabetes increases stroke risk.
Carotid artery disease	A diseased or narrowed carotid artery can become blocked by a blood clot causing a stroke or can be a source of an embolus to the brain.
Heart disease	Abnormal heart rhythms such as atrial fibrillation increase the risk of stroke due to the chance of blood clots being formed, dislodged and traveling to the brain obstructing blood flow.
TIA's	TIA's are strong predictors of stroke. A person who has suffered a TIA is 10 times more likely to have a stroke and develop permanent neurological deficit.



**Stroke**

# **Signs and Symptoms of Stroke**

Early detection of the warning signs of a stroke is crucial. The signs and symptoms can vary greatly depending on which part of the brain is affected. In general, these can include the sudden onset of or sudden awakening with:

- paralysis or weakness on one side of the body (hemiplegia, hemiparesis)
- facial droop on one side
- altered level of consciousness (from confusion to unconsciousness)
- change in personality or mood
- headache or dizziness
- impaired speech
- blurred vision
- poor coordination

An altered level of consciousness or coma is more common with hemorrhagic stroke compared to ischemic stroke. Often this is due to an increase in intracranial pressure.

## Stroke

# Physical Exam

The first step in evaluating a potential stroke patient is to conduct an initial assessment to determine SICK or NOT SICK. A SICK patient is physiologically unstable based on key clinical indicators. A NOT SICK patient is physiologically stable. He or she still may require BLS treatment or ALS evaluation.

A physical exam starts with a set of vital signs to establish a baseline. Look for other explanations of stroke-like symptoms such as trauma, medic alert tags, drug use or diabetes. If available, blood glucometry is an excellent tool to help assess the cause of altered mental status.

An important part of the physical exam is testing neurological function with the Cincinnati Prehospital Stroke Scale. Additionally, you may check both hands for equal grip strength and check if the individual can push with both feet equally.

### SICK vs. NOT SICK

A **SICK** patient is one who can die quickly unless you initiate aggressive BLS and ALS treatment and rapid transport. This patient appears physiologically unstable as indicated by key clinical signs.

A **NOT SICK** patient is one who can be ill or injured, but not severely enough to be life threatening. This patient appears physiologically stable and does not need immediate ALS measures at this time. BLS treatment can still be required!

The **SICK/NOT SICK** choice is a very important medical decision. In some cases, it is a life-saving choice. You should be able to decide within the first minute of contact whether or not the patient is critically ill. You do this by forming a clinical picture. Once the decision is made, responder actions should proceed in a manner appropriate to the patient's condition.

## Stroke

# Cincinnati Stroke Scale

The Cincinnati Prehospital Stroke Scale is a simplified version of the National Institutes of Health Stroke Scale. It is accurate in identifying patients with stroke. The results of the test you perform will be used in further diagnosis and treatment at a hospital. An abnormal finding in any of the three tests strongly suggests a stroke.

Test	Normal	Abnormal
Facial droop	Both sides of the face move equally	One side of the face does not move as well as the other
Arm drift	Both arms move the same or both arms do not move at all	One arm drifts down compared to the other or one arm does not move
Speech	The patient says correct words with no slurring of words	The patient slurs words, says the wrong words, or is unable to speak

**Facial droop** is the first test of the Cincinnati Prehospital Stroke Scale. Ask the patient to show his or her teeth or smile. Watch closely to observe that both sides of the face move equally. The test results are immediately "abnormal" if one side of the face does not move as well as the other.

To test **arm drift**, ask the patient to close his or her eyes and extends both arms straight out for 10 seconds. The palms should be up, thumbs pointing out.

Check **speech**, the third part of the stroke scale, by asking the patient to repeat a simple phrase such as "Firefighters are my friends" or "The sky is blue in Seattle."

## Stroke

# Patient History

Stroke patients frequently report a loss of motor function and/or a change in speech pattern. Additionally, some patients experience an altered level of consciousness. The chief complaint and time of onset are key in the assessment of stroke.

Use the **SAMPLE** technique to determine if there is a history of:

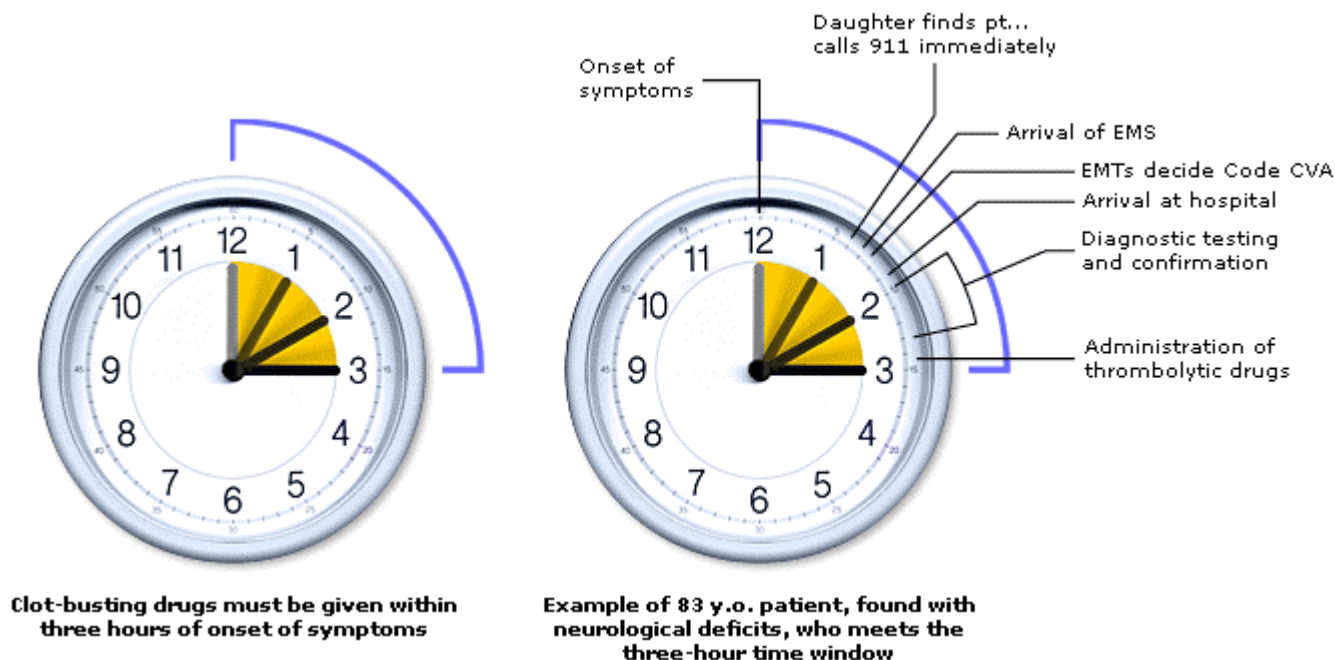
- hypertension
- blood thinners or anticoagulants
- arteriovenous malformation (AVM)
- cerebral aneurysm
- prior stroke

<b>Symptoms</b>	<p>The symptoms of a stroke are related to the area of the brain that is ischemic. With a hemorrhagic stroke the symptoms are more generalized and usually more severe (for example, unconsciousness and vomiting).</p> <p>The five most common symptoms occur suddenly:</p> <ul style="list-style-type: none"> <li>▪ numbness or weakness of face, arm or leg, especially on one side</li> <li>▪ confusion, trouble speaking or understanding</li> <li>▪ difficulty seeing in one or both eyes</li> <li>▪ difficulty walking, dizziness, loss of balance or coordination</li> <li>▪ severe headache with unknown cause</li> </ul>
<b>Allergies</b>	May influence drug selection
<b>Medications</b>	Indicate past history, may be a cause of CNS symptoms
<b>Past medical history</b>	Indicates stroke risk factors
<b>Last oral intake</b>	Not important in etiology but may be important in treatment
<b>Events prior</b>	May suggest alternate cause of symptoms. It is imperative to determine the time of symptom onset. Family, friends or care provider may need to provide information about the medical history and current episode.

## Stroke

# Time of Onset

In order to treat an ischemic stroke with clot-busting drugs, it's crucial that hospital staff know the exact time of onset of the symptoms. Thrombolytic drugs must be given within three hours of stroke onset.



You must quickly gather information regarding onset of symptoms from the patient, family members and caregivers. Be aware that from the moment a patient arrives at the hospital it takes time for the stroke team to make an assessment and administer the thrombolytic therapy.

Therefore, if the onset of symptoms was one or two hours prior to your arrival, you will have little time to waste in order to make three-hour window.



**Try to determine the precise time of onset of symptoms but keep scene and transport times very short.**

## Stroke

# Care for Stroke

Protecting a patient's airway and ensuring adequate respirations are your most important tasks in caring for a potential stroke patient. Keep the airway open and remove any secretions that can be aspirated.

Provide ventilatory assistance with a bag-valve mask if the patient's breathing efforts are inadequate. Proper positioning is important, depending on the patient's airway needs. Administer oxygen if the patient's oxygen saturation level is below 95% or there are signs of hypoxia.

If the patient is a candidate for clot-busting therapy and it appears he or she will be able to receive the therapy within the three-hour time window from onset of symptoms, initiate immediate and rapid transport to an appropriate medical facility.

## Airway and Breathing

A stroke can affect an individual's ability to maintain an open airway and adequate respirations. You must monitor and protect the airway. Administer oxygen via a non-rebreathing mask or assist ventilations with a bag-valve mask if respiratory effort is inadequate.

For the SICK (unstable) and unconscious stroke patient, position in a supine position or in the most appropriate position to control the airway and maintain good ventilation.

For a NOT SICK (stable) stroke patient who is alert, consider a position of comfort or position on the back with head and shoulders slightly elevated.

For someone with a decreased LOC, patent airway, adequate ventilations and stable vital signs, consider the recovery position to protect from vomiting. If you choose the recovery position, place the patient affected side down. This allows free movement of unaffected limbs.

In an unconscious patient, watch for a tongue that is blocking. Consider inserting an airway adjunct such as an oral airway if required to maintain a patent airway. Be alert for saliva and other secretions that can be aspirated into the lungs. Suction will also be important as well as proper positioning.

Remove dentures and false teeth, if you believe they will become an airway problem. Place the dentures in a clearly marked property bag or leave them at the patient's home.

## Additional Care Measures

Other BLS care measures include:

- request paramedics if indicated (e.g. history of cardiac disease, respiratory distress, airway compromise or unconsciousness)
- protect paralyzed limbs
- monitor vital signs
- maintain normal body temperature
- keep absolutely quiet and handle gently
- avoid unnecessary movement

### **Considerations Regarding Oxygen Administration**

Some stroke patients develop Cheyne-Stokes respirations with a decrease in oxygen saturation that can be readily reversed with oxygen supplementation. The results of a recent quasi-randomized, controlled trial do not support the use of supplemental oxygen therapy at three L/min for most patients with acute ischemic stroke.

However, patients with acute stroke should be monitored with pulse oximetry with a target oxygen saturation level of 95%. Supplemental oxygen should be administered if there is evidence of hypoxia by blood gas determination, desaturation detected by pulse oximetry or there are other specific reasons.

The bottom line is this: There is no need for supplemental oxygen for a stroke patient unless the pulse oximetry falls below 95% or there are signs of hypoxia.

## Stroke

# Short Scene Times

Victims of stroke often deny or rationalize their symptoms which further delays treatment at the hospital. Patients who can be eligible for clot-busting drugs must be transported to the appropriate hospital immediately. You should notify the hospital that a possible stroke patient is en route so they have time to prepare.

Revascularization by thrombolysis **must be initiated within three hours** of the onset of a stroke. You must avoid delays particularly if the patient waited before calling for help.



**Short scene and transport times are important.**



## Stroke

# Summary

The following key points were covered in this module:

The three regions of the brain are the **cerebrum**, **cerebellum** and **brain stem**.

The two basic types of stroke are **ischemic** (blockage) and **hemorrhagic** (rupture).

An ischemic stroke can be caused by a **thrombus** which is a clot that forms in a cerebral artery or an **embolus** which is a clot that travels to the brain.

The **signs and symptoms of a stroke** may include:

- paralysis or weakness on one side of the body
- facial droop on one side
- altered level of consciousness
- change in personality or mood
- headache or dizziness
- impaired speech
- blurred vision
- poor coordination

The three tests of the Cincinnati Prehospital Stroke Scale are **facial droop**, **arm drift** and **speech**.

In your focused history it is important to determine **time of onset** of symptoms. This helps determine if a patient meets the three-hour window for clot-busting therapy.

**Short scene and transport times** are vital particularly if the patient waited to call 911 after the onset of stroke symptoms.